THE FIRST RADIO-TELEGRAPH TRANSMISSION

by **ROWLAND F. POCOCK**

Marconi is generally credited with the invention of radio, but evidence suggests that Sir Oliver Lodge transmitted genuine radio signals almost a year earlier, although he did not appreciate the significance of his achievement at the time and failed to follow it up.

IT IS generally acknowledged that Sir Oliver Lodge (1851–1940) made a major contribution to the evolution of the scientific apparatus which was later developed into the earliest radio transmitters and receivers. Most historians also quote his memorial lecture for Hertz, delivered at the Royal Institution on the 1st June 1894, and his subsequent book based on this lecture,[1] as the most important factors in publicising the scientific basis of the means of generating and detecting Hertzian waves.

This article makes two further claims for Lodge: it shows that he was the first experimenter to demonstrate publicly the transmission of Morse signals by Hertzian waves and their reception on telegraphic equipment, and that this demonstration to the British Association was the direct cause of the subsequent invention of three systems of radio telegraphy.

Preece's prediction

There were many predictions of radio telegraphy in the 1890s, but that made by W. H. Preece (1834–1913, later Sir William Preece, C.B., F.R.S.), at the Oxford Meeting of the British Association on the 13th August 1894, was particularly significant. Preece was known as the inventor of a promising system of wireless telegraphy based on electromagnetic induction, and his official position as engineer-in-chief of the General Post Office gave him especial authority among telegraph engineers. Above all, his prophecy was made only the day before Lodge's demonstration, and prepared Lodge's audience to appreciate the full significance of his experiments.

Preece, speaking at a meeting of Section G (mechanical science) of the British Association, stated that:[2]

'The mechanism of the mode of signalling across space is not difficult to follow. Its analogue is a flash of light seen at a distance. Energy is expended, say, in a lighthouse. The energy assumes the luminous form exciting the ether to undulate with a frequency of many millions per second, which, acting on the retina of the eye, produces the sensation called light. The burning of the oil lamp in the lighthouse is the primary source of energy; the rapid undulations of the ether propagated in straight lines at a velocity of 186000 mile/s are the radiation, transmitting this energy in a waveform to the distant ship; the eye is the apparatus which transforms the energy of the light waves into a form which excites consciousness in the brain. In our electrical experiments, the primary energy is in the current form; the comparatively few alternations per second excite waves in the ether of a few hundreds per second only. But these oscillations of the ether or electric waves are of the same character as those of light; they move with the same velocity, and when they fall on a sympathetic secondary conductor they excite in that conductor currents of electricity of the same frequency; and if a telephone be inserted in that circuit and applied to the ear sounds and musical notes are distinctly heard which, by pre-

Oliver Lodge in 1894; he is chiefly remembered for his investigations into the propagation of electromagnetic waves
Photo: Science Museum, London

concerted measures, such as the use of the Morse code, can be utilised for the transmission of messages.'

It is rather interesting that this extremely accurate forecast of the properties of a radio telegraph was based on a misconception, as Preece believed that he was generating true Hertzian waves in the inductive circuits of his telegraph. However, this error was not important: engineers who understood the true nature of radio waves could appreciate their telegraphic potential from Preece's lecture.

Lodge's demonstration

The principal event of the meeting on the 14th August 1894 was a joint session of the physiology and physical-science sections to hear and discuss a theory of the nature of vision based largely on Clerk Maxwell's electromagnetic theory. Prof. Lodge (as he then was) assisted at this session by a series of demonstrations designed to explain the properties of electromagnetic radiation to biologists, who might not be expected to appreciate the latest physical research. Lodge's demonstrations were, however, deservedly popular, and many physicists and engneers also attended in order to see his experiments.

A contemporary report[3] says:

'Prof. Oliver Lodge described some experiments to illustrate Clerk Maxwell's theory of light. He began by saying that his experiments referred to the waves generally known as Hertzian waves, though Maxwellian waves would be a more correct term. Various detectors of electric radiations were known, but the most sensitive was one which depended on the breaking down of the resistance of a bad electrical contact when electric surgings passed across it. Such a bad contact could be made by a row of iron borings in a tube, or by a steel spring with its end resting on a metal plate. These instruments he called 'coherers' . . . Prof. Lodge then described an electrical theory of vision . . . Between the stimulus of lightness and darkness there would be persistence of vision. Prof. Lodge showed an experiment to illustrate this, the coherer being restored by periodic tapping applied by a clockwork arrangement. For a continuous radiation, the coherer showed continuous indications which died away when the radiation ceased.'

Lodge himself has described[4] what these 'indications' were:

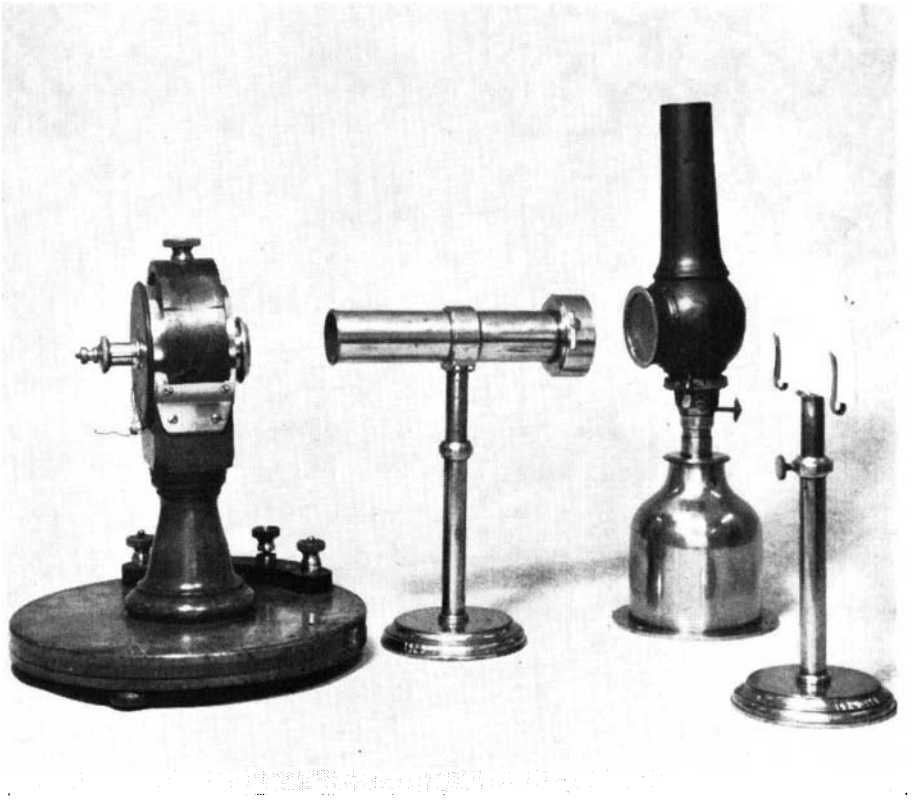
'These long and short signals obviously corresponded to the dashes and dots of the Morse code; and thus it was easy to demonstrate the signalling of some letters of the alphabet, so that they could be read by any telegraphist in the audience—some of whom may even now remember that they did so.'

The same source provides a description of the apparatus used for this Morse transmission. Lodge gives this description of his transmitter:

'The sending instrument was a Hertz vibrator actuated by an ordinary induction coil set in action by a Morse key. This apparatus was in another room, and was worked by an assistant.'

And he also states:

'The receiving apparatus was a filings tube in a copper hat, in circuit with a battery, actuating either a Morse recorder or a tape, or, for better demonstration to an audience, a Kelvin marine galvanometer, as first used for Atlantic telegraphy, before the siphon recorder replaced it. The instrument was lent to me by Dr. Alexander Muirhead . . . When the Morse key at the sending end was held down, the rapid trembler of the coil maintained the wave production, and the deflected spot of light at the receiving end remained in its deflected position so long as the key was down; but when the key was only momentarily depressed, a short series of waves was emitted, and the spot of light then suffered a momentary deflection.'



Kelvin marine galvanometer, as used by Prof. Oliver Lodge in his demonstration of the properties of electromagnetic radiation at a British Association meeting in 1894
Photo: Science Museum, London

This is the earliest recorded instance of the transmission and reception of a Morse signal by radio waves, and is clearly of great historical importance. Unlike so many of the claims which have been advanced on behalf of obscure 'inventors' of radio telegraphy, this transmission was made at a public demonstration before a qualified audience who could assess its merit.

It is even more significant that Lodge chose a Kelvin galvanometer for his receiver and a standard Morse key to actuate his transmitter: the engineers in the audience will have noted that the signals were originated and finally displayed on standard telegraph apparatus, albeit obsolete apparatus. Lodge had not merely shown that radio telegraphy was possible, he had also shown that it was a practicable extension of the existing telegraph service.

Response

There is no doubt of the reception given to this demonstration, or of the impression which it made. *Nature* reported:[5]

'The audience, which filled every part of the large museum lecture room, repeatedly showed its warm appreciation of Prof. Lodge's beautiful experiments.'

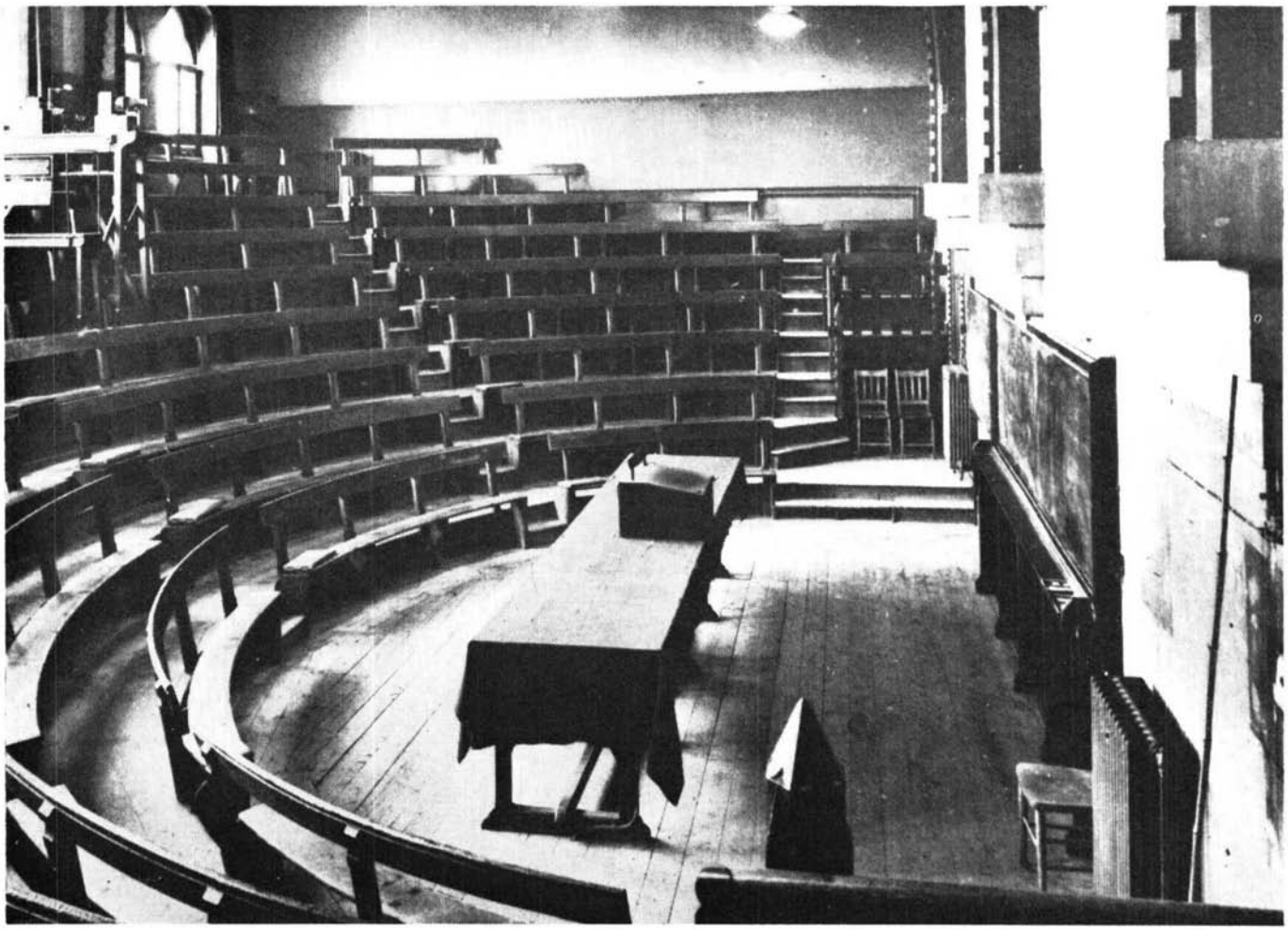
The distinguished scientists who saw the demonstration understood all its implications. Lodge later revealed:[4, 6]

'Lord Rayleigh . . . said, "If you follow that up, there is a life work in it", and he was quite right; but I didn't follow it up effectively . . .

'I was too busy with teaching work to take up telegraphic or any other development . . .'

Fortunately, others carried on the work that Lodge had temporarily abandoned. Marconi was attracted to the study of Hertzian waves by reading a magazine article when holidaying in Lombardy, according to family tradition related[7] by his daughter. Capt. Henry Jackson, R.N., later stated:[8]

'In September 1896 . . . Mr. Marconi



The Museum theatre, Oxford, where Prof. Oliver Lodge demonstrated the transmission of Morse signals by radio waves on the 14th August 1894. Shortly after this photograph was taken in 1859, the theatre was gutted by fire, and has since been completely rebuilt
Photo: Delegates of the Science Area, Oxford University

informed me that he had been working at his system for at least two years, mostly at his home in Italy.'

Jackson's comment suggests that the article seen by Marconi was published at some time in the autumn of 1894. Until more information is available about the sources of Marconi's work, it is impossible to assert that Lodge was the originator of his work, but the coincidence of dates and the general lines of Marconi's research suggest that this article and later papers which Marconi discovered in the library of the University of Bologna were written with a knowledge of Lodge's work.

There is a more direct link with the work of the Russian physicist Alexandr Popov. Prof. Süsskind has shown[9] that Popov was aware of Marconi's experiments as early as September 1896, when these had been publicised only at the British Association. The BA records were therefore available to Popov; he must have known of Lodge's demonstration in 1894, and his work on atmospheric electricity early in 1895 acknowledges Lodge's book as one of his sources.

A third experimenter—Capt. Henry Jackson, R.N.—demonstrated the transmission of Morse signals by radio in 1896. Jackson based his apparatus on the equipment used by Dr. Bose of Calcutta for investigating refractive indices at radio wavelengths.[10] Bose himself derived his equipment from descriptions of Lodge's experiments. It is, however, possible that the direct source was the Royal Institution lecture and not that given to the British Association.

Invention of radio

It is very tempting to suggest that the preceding evidence is enough to credit Lodge with the invention of radio. Certainly, if Lodge had been born a Russian he would now be known as the 'inventor of radio' in the Soviet Union. He transmitted genuine radio signals with conventional telegraphic equipment on the 14th August 1894: Marconi certainly did not equal this achievement until June 1895,[9] while the earliest claims for Popov and Jackson are the 24th March 1896[9] and the 20th August 1896,[10] respectively.

However, the first demonstration is not usually accepted as sufficient in itself to demonstrate priority of invention in Great Britain unless it is accompanied by some evidence of subsequent development to a practical system of commercial value. Lodge did not fulfil this second requirement: we have already seen that, by his own admission, he did not appreciate the significance of what he had achieved, and he did not resume radio experiments until after hearing of Marconi's system in September 1896.

The Oxford demonstration therefore does not upset the pre-eminence usually accorded to Marconi, except that the alleged private transmissions witnessed by members of Marconi's family in the early summer of 1895[7] cannot be considered to be the first transmission of Morse signals by radio waves. It has been recognised generally that, although he was unaware of Lodge's work, the sources used by Marconi derived ultimately from Lodge, and this article does not therefore contradict the accepted opinion. It does, however, suggest that there is a much stronger and more direct link between Lodge's work and the ultimate use of Hertzian waves for telegraphy than is commonly appreciated.

Thanks are due to the staffs of the Oxford City Libraries, the Nottingham City Library and the Guildhall Library, London, for their help and patience in tracing the various documents used in preparing this article. Reference 8 from Capt. Jackson is taken from a letter now in the UK Public Record Office (ref. ADM 116/570) and is quoted here by permission of the Comptroller of HM Stationery Office. Particular help has been given by G. E. S. Turner, University Museum, Oxford, who has assisted in establishing the general background and identifying the Museum theatre where Lodge gave his demonstration.

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